show greater power of will than the professor himself. Two German journals, however, report that the experiment succeeded, but one of them expresses the hope that it did not, on account of the grave consequences that might have befallen the country had the Queen really developed this high degree of suggestibility.

We have above attempted to present to our readers a digest of the chief representative books illustrating the different lines of experiment and observations and the different theoretic standpoints lately developed concerning hypnotism. There are other large works and countless smaller ones, besides all the contents of the *Revue de l'Hypnotisme*, edited by Dr. Edgar Berillon, and a growing number of works of French fiction occupied either chiefly or incidentally with multiplex personality, telepathy, transfer, or other spurious or genuine phenomena of hypnotism. In a future number we hope to publish results of a line of research already long under way in the psychophysic rooms of this university, which we believe shed additional light on one important group of these facts. One moral of all this movement is most obvious and impressive, viz. that physicians cannot study these phenomena with safety to their scientific reputation without more training in modern psychology than even the best medical schools either in France or in our own country now afford. To this we shall recur at length later.

III.—EXPERIMENTAL.

Ueber Holmgren's vermeintlichen Nachweis der Elementarempfindungen des Gesichtssinns. E. HERING. Pflüger's Archiv, Vol. 40, p. 1.

Holmgren is supposed to have proved, by some experiments which he described before the Medical Congress in Copenhagen in 1884, that the Young-Helmholtz theory of color sensation is the correct theory. His plan was to throw a very small and sharp image of a very small hole in a metal plate on the retina. If the diameter of the image is smaller than that of a cone, then white light ought to look red, green or violet according as it falls upon one or another of the cones of a cone triad ; if it falls half way between two it ought to look purple, yellow or blue, and only when it hits all three equally would it look white. If only saturated yellow light is allowed to come through the hole it may look red or green, but never violet or white. A white hole ought then to look in general colored, and only occasionally white ; that is, provided (1) that the theory is true, (2) that a small enough image can be produced, and (3) that in spite of the constant, rapid, involuntary motions of the eye, the different sensations furnished by the different cones can be distinguished in consciousness. Holmgren succeeded in his experiments with homogeneous yellow light from a spectrum. He was less successful with blue light, and he does not seem to have tried white light. Hering criticises his method and, on repeating his experiments, failed to obtain his results.

Holmgren says that after struggling for some time with the difficulty of producing a sufficiently sharp image on the retina, he hit upon the idea of using a telescope, and that this instrument must hereafter be looked upon as an indispensable aid to all experiments of this sort. Hering says that this is surprising ; for producing a

small sharp image one should use what Volkmann calls a makroscopic arrangement, that is, the objective of a telescope so arranged that the real, diminished image formed by it may be looked at by the naked eye at the proper distance for distinct vision. Spherical aberration is to be guarded against by a diaphragm with opening smaller than that of the pupil, but not so small as to allow insufficient light to pass through, nor as to let diffraction about the edge interfere with the image. This arrangement is what is always used to determine the fineness of vision of the retina, and to find out how small a colored object must be to lose its color. If a hole 1 mm. big is looked at at a distance of 1 m. its image is already less than the diameter of a cone in the fovea; if it is put at a distance of 5 m. and looked at with a telescope which magnifies five times there would be, theoretically, no change in the size of the image, and hence nothing would be gained by the telescope; but what Hering has called the aberration region (to be distinguished from the dispersion region, due to incorrect accommodation) *might* be greater than without the telescope and with the diaphragm, if the cone of light which enters the eye were greater. But the "bright spot" in front of the telescope is in general smaller than the pupil, and Hering does not say that he makes the aperture in his diaphragm *very much smaller* than the pupil; hence he does not seem to have established that the use of the telescope, with proper precautions, is particularly injurious.

Hering's next criticism is that Holmgren in moving his eye may have allowed now one side and now the other side of his pupil to become covered by the dark part of the telescope. This would lead to a known source of error. If a narrow line of light, formed by one card held parallel to another but several feet in front of it, be looked at with one eye, its borders appear red and blue. This is because the aberration region, which is usually white on account of the superposition of rings of color on one side of the green upon rings of color on the other side of the green, has now half of each set of rings cut off, and hence is blue on one side and red on the other, or, with yellow light, red on one side and green on the other. This objection would be without force if Holmgren had used absolutely homogeneous light, and Hering's next step is to show that he did not take sufficient precautions to that end. An absolutely homogeneous spectral light can be had only if the hole is exactly in the plane of (the image of) the spectrum. With the hole in any other position, rays of different refrangibility can get through, and as they are moving in different directions, a change in the position of the eye will cause the spot to look now of one color and now of another. That yellow should easily become red or green, but that green should not become yellow and blue, is owing to the fact that with a feeble light the yellow and blue of the spectrum are of particularly feeble intensity. A very feeble spectrum looks red, green and violet only, as is well known.

Hering repeated the experiments, using a metal plate with a very thin spot in it, and a conical hole in the centre of the thin spot .09 mm. in diameter at the small end. The plane of the hole was in the plane of the spectrum, and 20 cm. in front of it was a Hartnack objective system with a diaphragm. When the eye, properly guarded from extraneous light, was at the right distance, different for different wave lengths, the calculated size of the image was less than that of a small cone, and sometimes only one fourth as great.

With this arrangement the Holmgren effect was not obtained, but yellow light did become red and green, both with and without a telescope, when the arrangement of the apparatus was inexact. It seems singular that Holmgren did not try the light of sodium in a Bunsen flame. With the sodium, lithium and thallium flame Hering was not able to obtain any change of color at all. He observed, what was known before, that yellow becomes white with diminished intensity, green very rapidly so, and red not at all. He observed also that weak blue points cannot be seen at all by direct vision (on account of absorption by the yellow spot), and that green and white points are strikingly brighter in indirect vision.

Holmgren says that white light might be tried, but that, "*der Kürze wegen*," he used only spectral light. There are certain points in nature which can be looked at in much shorter time than small holes lighted up by the spectrum,—they are the stars. Even when looked at through the telescope they present no change of color with change of position of the eye: it seems impossible that this should be the case if Holmgren's experiments were to be relied upon.

Hering's argument is not at all skillfully carried out, but nevertheless it seems to be quite conclusive against Holmgren's inferences. It does nothing to *disprove* the Young-Helmholtz theory of color sensation, though it would be very effective against it if it could be shown that the image on the retina had been shorn of its aberration circle. Helmholtz himself has said, however, that there is no reason for supposing that the three different sensations may not be three different activities in one and the same cone, and that the supposition of three cones is kept up merely for the sake of greater facility in speaking about the matter. CHRISTINE LADD-FRANKLIN.

Die Gesetzmässigkeit des Helligkeitscontrastes. H. EBBINGHAUS, Berlin. Sitzber. der K. Preuss. Akad. der Wissensch. zu Berlin, 1887, Sitzung vom 1. December. 15 pp.

To this very difficult topic of experimental psychology Dr. Ebbinghaus, whose study of the laws of memory is deservedly well known, makes a very valuable contribution. He succeeded in preparing a series of papers varying through shades of gray from the whitest white to the blackest black, and was able to get 53 such shades differing by objectively equal differences of brightness. The general tone of the grays was approximated to that produced by the rotation of pure black with pure white. He cut disks 2 cm. in diameter from these various papers, and placing a given disk on a background of its own shade, he found what shade of disk he had to place upon a background of a different degree of brightness in order that the two disks shall seem equally bright. It is evident that the difference in brightness of the two disks measures the amount of contrast. Working with great attention to details and with conditions analogous to those that the eye is subjected to in our every-day vision, he deduced from a large number of experiments the following laws: 1. Disks placed upon a background darker than their own shade of gray have their brightness *increased* by an amount that is closely proportional to the difference in brightness between disk and ground, but is independent of the absolute brightness of the ground. On the average the brightening by contrast is from one quarter to one fifth of the difference between disk and ground. 2. A disk placed upon a darker ground has its brightness *diminished* proportionally to